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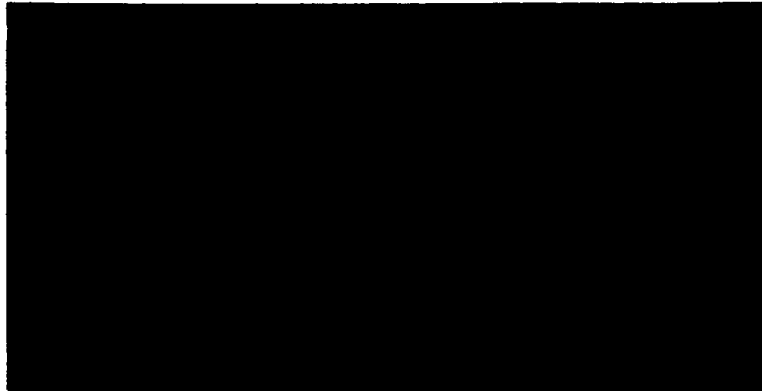
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ORBITAL OPERATIONS STUDIES

Natural Resources Research Institute
in association with the
National Aeronautics and Space Administration

College of Engineering
University of Wyoming
Laramie, Wyoming

THE UNIVERSITY OF WYOMING
COLLEGE OF ENGINEERING



NATURAL RESOURCES RESEARCH INSTITUTE.

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August 6, 1965

Orbital Operations Study

Grant No. NsG-658

Second
Semi-Annual Progress Report

November 15, 1964 - May 15, 1965

Office of Grants and Research Contracts
Attention: Code SC
National Aeronautics and Space Administration
Washington, D. C. 20546

Gentlemen:

This second semi-annual progress report describes the work accomplished under Grant No. NsG 658 from November 15, 1964 through May 15, 1965.

As indicated in this report, activities during this mid-school year period were at a lower level than during the previous period. Nevertheless one technical report was completed and good progress was made on the construction of some "informatic" recording equipment.

Sincerely,

John C. Bellamy, Director

Orbital Operations Study

Grant No. NsG-658

Second Semi-Annual Progress Report

November 15, 1964 - May 14, 1965

1. Purpose

In review of our "Plan of Study - Technical Progress Report No. 1" the purpose of this Orbital Operations Study is "To help establish more productively effective ways of controlling orbital operations." Specifically, this help is to be provided in the form of Informatic Data Research whose goal is:

"To establish the principles and practices of utilizing newly possible informatic ways of representing large sequences of numbers as concise complete "pictures" or portrayals of information which can be acquired, processed, recorded and reprocessed in numerical detail only with appropriate automatic equipments in appropriately organized large scale operations."

2. Personnel

The following personnel were involved in this research on a part-time basis (in addition to their class-room duties) during this semi-annual period. Charges against this grant were made only for the full time services of those marked with ** and for the part time services of those marked with*.

- * John C. Bellamy, Director, Professor of Civil Engineering
- R. Kenneth Beach, Professor of Electrical Engineering
- * Willis L. Everett, Associate Professor (Research)
- Richard J. Jiacoletti, Assistant Professor of Mechanical Engineering
- C. Norman Rhodine, Assistant Professor of Electrical Engineering
- Donald L. Veal, Assistant Professor of Civil Engineering
- ** Dennis J. Knowlton, Instructor (Research)
- ** Dennis M. Kiser, Instructor (Research)
- A. L. Riemenschneider, Instructor of Electrical Engineering

Graduate Research Assistants:

- | | |
|------------------------------|---------------------------------|
| Lt. Rudolph P. Arnold (M.E.) | * David Fjeld (Math) |
| * Larry D. Baccari (C.E.) | * Roland H. Lamberson (Physics) |
| * James E. Cady (E.E.) | * Ronald A. Stahla (E.E.) |
| * Thomas C. Ensign (Physics) | * James W. Stugart (E.E.) |

3. Reports

The attached technical report "Proposed Nautical Units of Length and Time," was completed and published as a mimeographed Information Circular No. 28 of the NRRI during this period. Several copies of this report were forwarded in this form to the Control Center Research of the Goddard Space Flight Center and to the OGO Office of NASA Headquarters for review concerning publication by NASA. (This report was subsequently delivered at the national meeting of the Institute of Navigation in Long Beach on June 21, 1965; it resulted in the establishment of an ad-hoc committee on "Operational Units of Length and Time" of the Institute of Navigation; and it has been accepted for publishing in "Navigation.").

Briefly, one of the most important aspects of portraying physical occurrences in terms of numerical quantities is the selection and use of appropriate units of, especially, length and time for the problem at hand. In the case of Orbital Operations, most of the physical quantities of interest are directly associated with the shape and size of the planet Earth. Consequently it is desirable (or even necessary) to formulate numerical portrayals in terms of numbers of units of length and time which are characteristic of the size and rate of rotation of the Earth. Although the meter and ephemeris units of time have been so defined, their utility for orbital operations is seriously limited since (1) sexagesimally (rather than decimally) related units of angle and time are in common use and (2) rates of rotation with respect to the stars (rather than the Sun) are of most direct orbital interest.

As described in detail in the attached report, these shortcomings for orbital operations can apparently be overcome by utilizing a sexagesimally related set of "circumferential" units of length based upon the current definition of the International Nautical Mile (of 1.852 meters). In addition, and of special importance to Orbital Operations, radial positions outside of the thin shell biosphere of previous human experience could well be evaluated in terms of a "nautical rad" defined to be the commensurate counterpart, 3,437.75, of the 21,600 nautical mile nominal circumference of the Earth divided by 2π . Similarly, a set of "nautical" units of time, defined to be the ratio 365.25/366.25 smaller than their "ephemeris" homonyms, could well be utilized as being nominally representative of the Earth's rate of rotation with respect to both the fixed stars and the Equinox.

4. Seminar

Another important aspect of portraying the occurrence of things of importance to Orbital Operations is to select and utilize portrayal techniques which clearly reflect the relationships among the many kinds of physical variables involved. Toward this end, a critical "Survey of the State of the Earth Centered Region of Space" was initiated in February. Its goal is "To isolate and identify the fundamental properties which best characterize the physical states of this region, with attention focused on the problem of finding portrayal techniques which will facilitate maximum use of the scientific information available."

This survey has been conducted primarily by Dr. Everett and Mr. Lamberson, with a critical constructive review being provided in a weekly seminar attended on the average by about eight interested personnel through the Spring Semester. The initial outline for topics of discussion for this seminar is:

- I. Properties of the Earth
 - A. Gravitation Field
 - B. Magnetic Field
 - C. Upper Atmosphere
 - D. Ionosphere
 - E. Van Allen Belts
- II. Properties of the Sun
 - A. Photosphere
 - B. Chromosphere
 - C. Sunspots
 - D. Prominences
 - E. Filaments
 - F. Flares
 - G. Magnetic Field
 - H. Radiation
- III. Properties of Interstellar Space
 - A. Interplanetary Gas and Radiations
 - B. Interplanetary Magnetic Fields
 - C. Acceleration Mechanisms
- IV. Interaction between the Sun and the Earth
 - A. Ionosphere
 - B. Van Allen Belts.
 - C. Fluctuating Magnetic Field of Earth
- V. Interaction between the Earth and Interstellar Space

5. Other Progress

Work also proceeded on each of the research areas mentioned in our First Semi-Annual Progress Report, namely on:

- The novel concepts of
 "Gravispheres and Pyrospheres,"
 "Triadic Digits," and
 "Uadic Numerals";
- The construction of a "Tabular-Converter-Recording Buffer"; and
- Computer programming.

During this reporting period, the initial construction and initial use-tests of the "Tabular Converter Recording Buffer" were completed, and good progress was made toward solidifying the foregoing novel concepts. All progress was slowed to an unexpected degree, however, by greater-than-anticipated problems associated with the substitution of the Philco 211 computer for those computers previously available in the University Computer Center.

In addition, the following three kinds of recording equipment which should be suitable for recording the informatic kinds of numerals were acquired during this reporting period.

- One Alden 60-Stylus Strip-chart Recorder (Purchased with grant funds)
- One 640-stylus Radition Incorporated "Radicorder" System (Provided by NASA)
- One Alden (Helical) Facsimile Transmitter-Receiver System (Provided by NASA)

Required modifications of the Alden 60-Stylus Recorder were also well started during this period.

6. Plans for the Next Period

Although the press of teaching duties during this period precluded the completion of more than one report, progress was made toward the completion - in all likelihood during the next reporting period - of reports on:

- "Magnetic-Hydrodynamic Relationships in the F-Region of the Ionosphere" by Everett and Lamberson
- "Definition and Characteristics of Gravispheres" by Ensign and Bellamy
- "Triadic Decimal Digits" by Jiacoletti and Veal
- "A Triadic Decimal Digit Printer-Reader Unit - Preliminary Design Considerations" by Rhodine and others.
- "A Tabular Conversion System" by Rhodine and others
- "Informatic Portrayals of Positional Data" by Veal and Fjeld.